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ANNONA SERICEA AND ITS ALLIES

By WILLIAM E. SAFFORD



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PREFACE.

The accompanying paper, by Mr. William E. Safford, of the United States Department of Agriculture, deals with a tropical American subgroup of the genus *Annona* here distinguished as a new section, *Pilannona*, with *Annona sericea* as its type. Ten species are recognized, of which seven are described as new. The older species are redescribed after a critical examination of the type specimens.

FREDERICK V. COVILLE,
Curator of the United States National Herbarium.

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ANNONA SERICEA AND ITS ALLIES.

BY WILLIAM E. SAFFORD.

INTRODUCTION.

In continuance of his studies in the Annonaceae, the writer finds that the silky annona of French Guiana (*Annona sericea* Dunal) is the type of a natural subgroup of the genus *Annona*, which should be segregated as a section. This will be composed of at least ten species, several of which have not hitherto received names. In addition to defining the section and characterizing the species, it has been possible in this paper to present photographs of a number of the type specimens, including that of *Annona echinata* and the flower of *A. sericea*, described and figured by Dunal in his classical monograph of the Annonaceae. For the photographs of the latter, the types of which are in the De Candolle Prodromus Herbarium, the writer is indebted to M. Augustin de Candolle. For that of *A. trinitensis* he is indebted to the Director of the Royal Gardens at Kew. The remainder of the photographs, including those of *A. spraguei*, *A. holosericea*, and *A. jamaicensis* were taken in Washington under the writer's direction.

The accompanying drawings were made by Mr. A. B. Boettcher and Mr. J. M. Shull, those of the essential parts being reproduced from camera lucida drawings of the writer.

SYSTEMATIC TREATMENT.

The species here described form a fairly well-defined genus section, for which the name *Pilannona* is proposed, to give it coordinate rank with the sections *Euannona* (based upon *Annona muricata* L.), *Atta* (including *Annona squamosa*, *A. cherimola*, and their allies), *Ilama* (based upon *A. diversifolia* Safford), *Annonella* (based upon *A. globiflora* Schlecht.),¹ and *Chelonocarpus* (based upon *A. scleroderma* Safford).² As in other natural plant groups there are

¹ See Safford, W. E. The Genus *Annona*: The Derivation of its Name and its Taxonomic subdivisions. Journ. Washington Acad. Sci. 1: 118. 1911.

² See Journ. Washington Acad. Sci. 3: 103-109. 1913.

certain species which appear to form connections with allied groups, so in the section *Pilannona* the type species, *A. sericea* Dunal, appears to be allied to the 6-petaled *A. paludosa* Aubl. and sometimes has 3 imperfectly developed inner petals; while, at the opposite end of the series, *A. jamaicensis* Sprague approaches *A. cherimola*, belonging to the section *Atta*. Notwithstanding these connecting links, the group may be regarded as sufficiently distinct, and the species composing it are most conveniently set apart for study as a section by themselves.

The section may be characterized as follows:

ANNONA, section PILANNONA Safford.

Flowers normally 3-petaled, spheroid or rarely oblong in bud, the petals valvate, thick, concave, and not keeled within nor triquetrous; receptacle convex, often clothed with short fine straight bristle-like hairs; stamens numerous, with the connective expanded into a terminal head above the two parallel pollen sacs, the surface of the head being either minutely papillose or echinate, and in some cases bearing a number of erect or slightly curved hairs; carpels numerous, crowded, more or less covered with sericeous hairs, with club-shaped styles and minutely tuberculate or echinate ovoid stigmas.

As compared with the common custard apples of commerce (*Annona reticulata*, *A. cherimola*, and their allies), the fruits of this group are small, in many cases no larger than a plum or peach and sometimes the size of a strawberry. In nearly all the species the surface of the fruit is velvety, especially during the early stages, and the seeds are surrounded by scant pulp. As the name indicates, the young growth of the type species and its close allies is sericeous or velvety, and the leaves of most of the species are more or less velvety or sericeous, at least on the lower surface. In a few cases they become glabrate at length.

KEY TO THE SPECIES.

- Peduncles in clusters of 2 or 3; flower buds depressed-globose; leaves oblong-acuminate, membranaceous, clothed beneath with soft brown velvety pubescence. A small tree of British Guiana and northern Brazil. 2. *A. jenmanii*.
- Peduncles solitary (in no. 1 sometimes geminate).
 Lower leaves of flowering branches orbicular; stigmas and connectives of stamens densely pilose or velvety. A small tree of Nicoya, Costa Rica. 5. *A. holosericea*.
 Lower leaves not orbicular.
 Bracteoles of peduncles linear-lanceolate, acuminate; leaves small, long-acuminate, membranaceous, glabrate. A small tree of Panama. 9. *A. acuminata*.
 Bracteoles of peduncles not linear-lanceolate, acuminate.
 Peduncle usually 3 times as long as the petioles, slender, softly pilose and recurved in fruit; leaves ovate or elliptical, membranaceous, persistently soft-tomentose beneath; fruit strawberry-shaped, without projecting points. A tree of southern Veracruz, Mexico. 4. *A. longipes*.
 Peduncles less than three times the length of the petioles.
 Leaves thickly tomentose beneath, oblong, acuminate; fruit covered with fleshy claw-like projections. A forest tree of Panama. 6. *A. spraguei*.

Leaves sericeous or subtomentose beneath or at length glabrate.

Leaves acute or gradually acuminate, membranaceous; midrib and lateral nerves reddish-sericeous beneath; fruit ovoid, echinate; flowers solitary or geminate. A tree of the savannas of French Guiana. 1. *A. sericea*.

Leaves abruptly or obtusely acuminate.

Fruit verrucose, strawberry-shaped; leaves shortly and obtusely acuminate. A tree growing on the island of Trinidad..... 3. *A. trinitensis*.

Fruit echinate, or with the carpels produced into points or tails.

Lowermost leaves of flowering branches broadly ovate-cordate, the carpels terminating in minute tail-like appendages. A tree growing on the Magdalena River, Colombia..... 7. *A. cercocarpa*.

Lowermost leaves elliptical or obovate.

Flowers globose in bud; fruit ovoid, the carpels terminating in recurved points. A tree of French Guiana..... 8. *A. echinata*.

Flowers oblong or ovoid in bud; fruit spheroid or oblate, the carpels terminating in incurved points. A tree of the island of Jamaica..... 10. *A. jamaicensis*.

1. *Annona sericea* Dunal.

SILKY ANNONA OF FRENCH GUIANA.

Annona sericea Dunal, Monogr. Anon. 69. pl. 5. 1817.

A small tree; young branches slender, clothed at first with soft ferrugineous or dark red silky hairs; leaves distichous; petioles short (4 to 8 mm. long), ferrugineous-sericeous; upper leaves on flowering branches longer and relatively narrower than those near the base, oblong to oblong-lanceolate or obovate-oblong, 10.5 to 18 cm. long and 3.5 to 5.5 cm. broad, acute or acuminate at the apex, short-acute or rounded at the base, membranaceous, finely and densely pellucid-punctulate, glabrate above with impressed midrib and inconspicuous lateral nerves (18 to 25 on each side), subtomentose beneath, the prominent midrib and slightly curved parallel nerves clothed with dark red or maroon silky hairs; lower leaves on the flowering branches ovate or elliptical, often obtuse or emarginate as in many other Annonaceae; flowers normally 3-petaled, globose in bud; peduncles solitary or sometimes in pairs, extra-axillary, straight, 11 to 16 mm. long, 1-flowered, appressed ferrugineous pubescent, with a minute caducous tomentose scale at the base and an inconspicuous bracteole near the middle; unopened flower buds 10 to 12 mm. in diameter; calyx gamosepalous, 3-lobed, the lobes broadly triangular-ovate, abruptly acuminate or cuspidate, clothed on the outside with appressed dark red hairs; petals broadly ovate or suborbicular (12 to 16 mm. long and 10 to 12 mm. broad), obtuse, thick, valvate, concave, clothed on the outside with fine ferrugineous-sericeous pubescence and on the inside with golden brown or pale fulvous tomentulum; torus 6 mm. in diameter, convex, clothed with straight yellowish diaphanous caducous hairs and bearing numerous crowded stamens 1.8 to 2.2 mm. long; filaments very short, flat; pollen sacs linear, parallel, 1.5 to 1.7 mm. long, pale straw-colored, the connective expanded above them into a hood-like covering, yellowish, finely papillose, covered with minute points and bearing a number of erect stiff

sharp whitish diaphanous hairs; carpels together with the styles about as long as the stamens, the ovaries rufous-sericeous, the styles club-shaped, chocolate brown, microscopically granular on the surface, the terminal stigmas swollen at the time of pollination and minutely tuberculate; fruit (immature specimen collected by Poiteau) ovoid or heart-shaped, muricate with sharp fleshy points, like a miniature fruit of *A. muricata* in appearance, 2.5 cm. long, 1.8 cm. in diameter; seeds small, ovoid, somewhat compressed and bearing a swollen caruncle at the base. (PLATES 85, 86, 91, A, facing p. 270. FIGURE 42.)

Type in the Prodrômus Herbarium of De Candolle at Geneva, collected some time during the latter part of the eighteenth century in French Guiana by Patris.¹

DISTRIBUTION: Guiana to Brazil.

SPECIMENS EXAMINED: FRENCH GUIANA—"Cayenne," 1795?, Patris, flower of type collection, also specimen from same locality with geminate peduncles, from Prodrômus Herbarium of De Candolle; Karouany, 1855, *P. Sagot* 7; without definite locality, 1817-1822, Poiteau, photograph of specimen in Kew Herbarium, from the Gay Herbarium, presented by Poiteau in July, 1824, to Gay, and by Dr. Hooker to the Kew Herbarium in February, 1868.

Annona sericea, though normally 3-petaled, has sometimes 3 additional inner petals. These when present are linear-lanceolate in shape and are sometimes imperfect, as in abnormal flowers of *A. globiflora*. They are alternate with the 3 outer petals and appear to close the seams between them, as if to protect the essential parts of the flower from moisture, as in the case of *A. angustifolia* Huber, a closely allied shrub of Brazil, regarded by Martius as a narrow-leaved variety of *A. sericea* (*A. sericea* var. *angustifolia* Mart.).² These 6-petaled forms appear to connect *A. sericea* with *A. paludosa* Aubl., in which the flowers are normally 6-petaled. *Annona paludosa* further resembles *A. sericea* in the soft, velvety lining of its leaves and its small, ovoid fruit covered with fleshy prickles, very much like the fruit

FIG. 42.—Fruit of *Annona sericea*. Natural size.

collected by Poiteau in French Guiana (fig. 42).³ The two species are undoubtedly distinct, both of them being recorded as common in French Guiana, where they are known by the common name *guimamé*. According to Sagot *A. sericea* is distinguished from *A. paludosa* as *guimamé savane*. The latter is known simply as *guimamé*, or as *corossol sauvage* (from the resemblance of its fruit to a miniature soursop).⁴

¹ Patris, J. B. "Médecin et botaniste du roi, et conseiller au Conseil-supérieur de Cayenne," for whom the genus *Patrisa* was named by Richard. "He collected with great zeal in French Guiana about the year 1795. His collection, which probably included twelve or fifteen hundred species, and which has been estimated at two thousand, on account of duplicates, was presented by the chevalier Turgot to Lhéritier and was acquired by A. P. de Candolle, when he purchased Lhéritier's herbarium. Patris's plants, which form more than half the Guiana species of the original herbarium of the Prodrômus, bear neither the signature of Patris nor a record of the exact locality in which they were collected. Patris was in communication with de Rohr and Rolander. His specimens were prepared with great care, and were probably represented by either a single sheet or by two or three." Sagot, Catalogue des Plantes de la Guyane Française. Ann. Sci. Nat. VI. Bot. 10: 367.

² Huber, Bol. Mus. Goeldi 5: 353. 1909.

³ See Aubl. Pl. Guian. 1: 611. pl. 246. 1775.

⁴ Sagot, Ann. Sci. Nat. VI. Bot. 11: 134. 1880.



ANNONA SERICEA DUNAL.



ANNONA SERICEA DUNAL.

In the original description of *Annona sericea* by Dunal the collector's name is not given nor does it appear in De Candolle's *Prodromus*. It is, however, to be found in the *Systema*.¹ The type is in an excellent state of preservation, and the drawing of it here presented (pl. 86) proves that Dunal's figure is fairly accurate, showing the flower to be extra-axillary, though he erroneously describes it as axillary, and the peduncles possibly to have been geminate, as shown in plate 85. He does not, however, figure the details of the essential parts of the flower, a deficiency supplied in plate 86. The flower of the type itself (see pl. 91, A), kindly lent for the occasion by M. Augustin de Candolle, is in excellent condition and has not the least appearance of being, as it actually is, more than a century old. In this type specimen the carpels and stamens are cemented in place by the glue-like exudation from the stigmas, to which some of the pollen grains still adhere.

The type plant collected by Patris formed part of Lhéritier's herbarium.² In another specimen of the same collection (pl. 85) and bearing a similar label the peduncles are geminate. The leaves are exactly similar to those of the type specimen, the lower surface of the young ones being covered with reddish silky hairs, while the older ones are subtomentose beneath and of an olivaceous color between the nerves, sharply contrasting with the bright reddish silky-tomentose midrib and lateral nerves.

Annona sericea is represented in Brazil by a narrow-leaved form, *A. angustifolia* Huber, to which reference has already been made. A broad-leaved ally on the Island of Trinidad, which was included by Sprague in *A. sericea*, is below segregated as *A. trinitensis*.

EXPLANATION OF PLATES 85, 86.—Pl. 85, photograph of specimen from type locality in the De Candolle *Prodromus Herbarium*, showing geminate peduncles. Natural size. Pl. 86, drawing of type. Natural size. Fig. a, flower of same with two petals truncated and one removed to show the essential parts; b, stamens of same showing the stiff hairs borne on the terminal, swollen connective; c, carpel composed of hairy ovary and style terminating in a minutely tuberculate stigma; d, apex of leaf, showing silky indument of lower surface. Fig. a, scale 3; b and c, scale 15; d, natural size.

2. *Annona jenmanii* Safford, sp. nov.

SILKY ANNONA OF BRITISH GUIANA.

A shrub or small tree; young branches slender, clothed with dense appressed ferrugineous hairs; leaves distichous; petioles 6 to 10 mm. long, frequently recurved, ferrugineous-sericeous; blades obovate-oblong to oblanceolate, the lowermost on the branchlets lanceolate, smaller than the succeeding ones but not broad and retuse as in *A. sericea*, 6 cm. long by 2 cm. broad, the larger 10 to 19 cm. long by 2.5 to 5.5 cm. broad, gradually acuminate at the apex and acute or cuneate at the base, membranaceous, pellucid-punctulate, sparsely pubescent above except along the impressed hairy midrib, at length glabrescent, clothed beneath with persistent chocolate-brown velvety pubescence except along the ferrugineous-sericeous midrib and parallel slightly curved lateral nerves (20 to 25 on each side); flowers normally 3-petaled; peduncles geminate or fascicled, extra-axillary, usually recurved, 10 to 15 mm. long, clothed with ferrugineous appressed hairs and with a minute broadly ovate obtuse bracteole near the middle and one at the base; unopened flower-buds 12 to 15 mm. in diameter, spheroid; calyx lobes broadly triangular, shortly and abruptly acuminate, clothed on the outside like the peduncle with appressed ferrugineous hairs; petals broadly ovate or suborbicular, obtuse (14 to 16 mm. long by 16 to 18 mm. broad), thick and coriaceous, clothed on the outside with fine dense velvety ferrugineous pubescence and on the inside with fulvous tomentulum; receptacle convex, clothed with short stiff fulvous hairs; stamens numerous, crowded, 1.9 to 2.4 mm. long, with a short broad filament and linear parallel pollen sacs surmounted by the swollen expanded

¹ DC. Reg. Veg. Syst. 1: 471. 1818.

² See footnote 1, p. 266 above.

connective, the latter papillose and bearing stiff erect or spreading somewhat curved acute hairs, abundant on the immature stamens and visible under an ordinary lens, at length more or less deciduous; carpels including the styles about as long as the stamens, club-shaped, terminating in a swollen tuberculate stigma; fruit not observed. (PLATE 87.)

Type in the U. S. National Herbarium, no. 703145, collected near Rockstone, British Guiana, April, 1899, by G. S. Jenman (no. 7546). This specimen was kindly sent to the U. S. Department of Agriculture by Mr. John F. Waby, acting government botanist at Georgetown, Demerara.

DISTRIBUTION: British Guiana and northern Brazil.

SPECIMENS EXAMINED: BRITISH GUIANA—Near Rockstone, April, 1899, *Jenman* 7546 (type). Brazil: Barra do Rio Negro [Manáos], October, 1851, *R. Spruce* 1868 (in Herb. De Candolle).

Annona jenmanii, though closely related to *A. sericea*, has its peduncles normally geminate or fascicled and is readily distinguished from the latter species by the dull chocolate brown, tomentose indument of the lower surface of the leaves, very much like that of *A. paludosa*, in which the midrib and lateral nerves are not conspicuous. In *A. sericea* the contrast of the bright reddish-sericeous midrib and nerves with the tomentose area between them is quite striking.

EXPLANATION OF PLATE 87.—Flowering branches, showing extra-axillary, clustered flowers. Natural size. Figs. *a*, *a'*, carpels with hairy ovaries and club-shaped styles terminating in tuberculate stigmas; *b*, *b''*, mature stamens, ventral view, with the heads of the connectives partly denuded of hair; *b'*, immature stamen, dorsal view, showing the two parallel pollen sacs, dehiscent along their median line, and the heads of the connective bearing spreading, stiff hairs. Figs. *a* to *b''*, scale 20; after camera lucida drawings of the author.

3. *Annona trinitensis* Safford, sp. nov.

SILEY ANNONA OF THE ISLAND OF TRINIDAD.

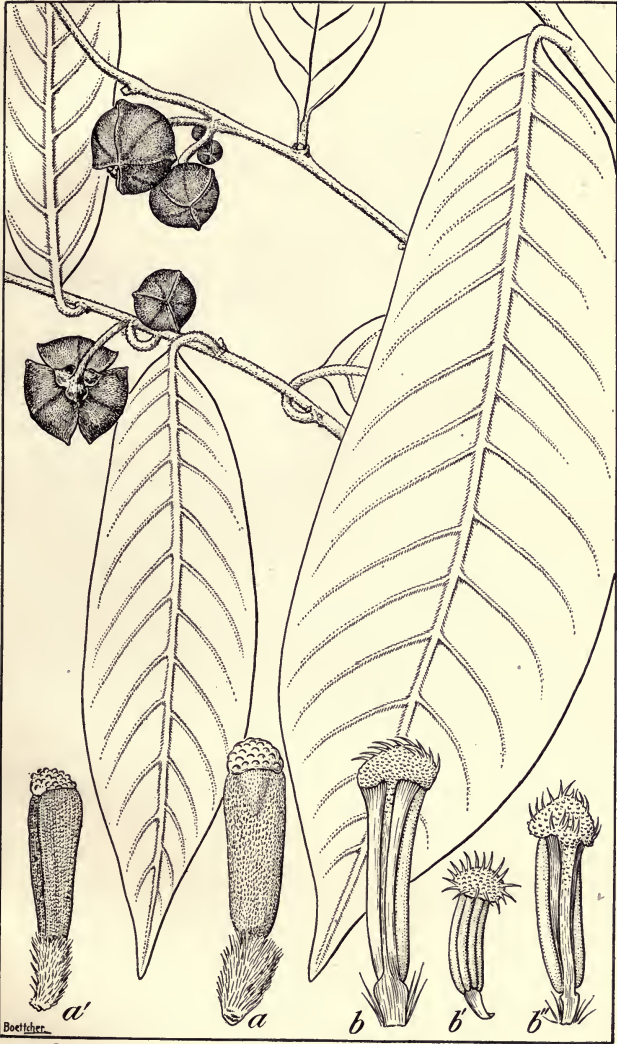
Annona sericea Sprague, Bull. Herb. Boiss. II. 5: 700. 1905, in part, not Dunal, 1817.

A tree 5 or 6 meters high; branches rather slender, the younger sericeous-tomentose with ferrugineous hairs; petioles 4 to 10 mm. long, sericeous-tomentose; blades ovate, elliptical, or obovate, obtuse or shortly and rather obtusely acuminate at the apex, cuneate or rounded at the base, 9.5 to 15 cm. long, 5.5 to 6.5 cm. broad, puberulous above except along the pubescent midrib, dark chestnut brown, clothed beneath with brown tomentulum or pubescence except along the midrib and nerves, these sericeous-tomentose; lateral nerves 12 to 16 on each side, slightly curved, not impressed above, prominent beneath; peduncle extra-axillary, solitary, 1-flowered, tomentose, at length glabrate, with a bracteole at or below the middle; flowers 3-petaled; calyx lobes broadly ovate, shortly acuminate, sericeous-tomentose on the outside, within sparsely sericeous at the base, elsewhere glabrate; petals ovate, obtuse, 18 to 20 mm. long, 15 mm. broad, sericeous on the outside; filaments 0.5 mm. long; anthers 1.5 to 1.75 mm. long; connective above the anthers broadly expanded into a head, papillose and bearing long hairs (Sprague); lower part of the style together with the ovary 1.25 to 1.5 mm. long, the upper part 0.75 to 1.25 mm. long; stigma broadly and obtusely ovoid, 0.25 to 0.35 mm. long; fruit similar to that of a strawberry (*Fragaria vesca*), 2.5 to 3.5 cm. long, about 2 cm. in diameter, warty; seeds 4.5 to 5 mm. long, 2.5 mm. broad. (PLATE 88.)

Type in the Kew Herbarium, collected on the Island of Trinidad, 1877–80, by August Fendler (no. 205).

DISTRIBUTION: Known only from type locality.

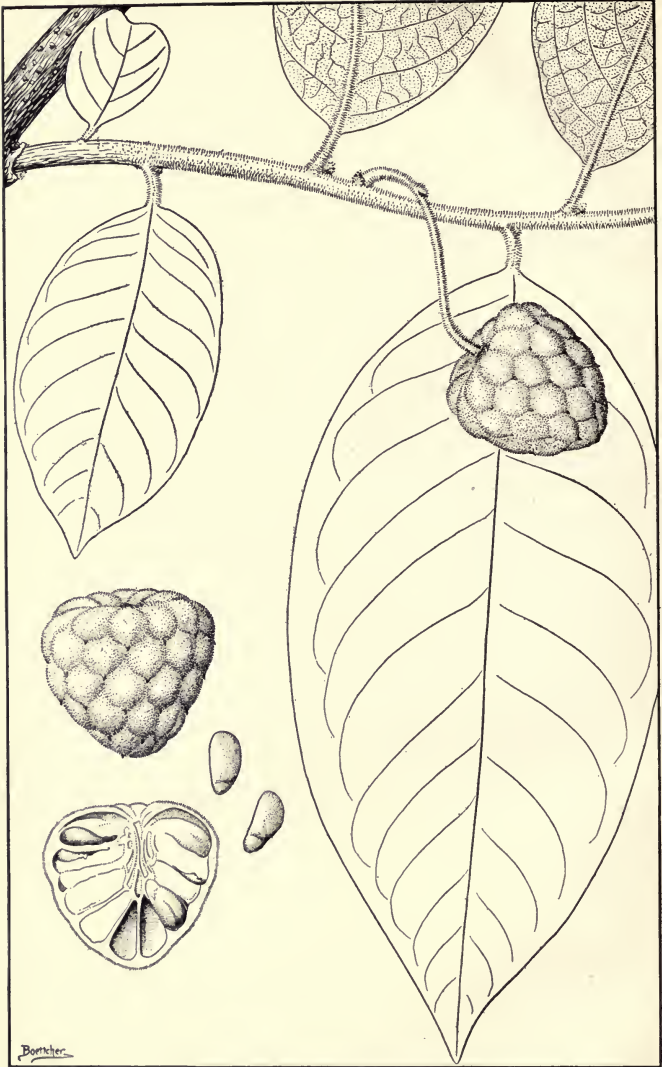
The type of this species was referred by Sprague to *Annona sericea* Dunal of French Guiana. From this species, however, it is separated by its relatively broader and more obtuse leaves, described by Sprague as "breviter obtusiuscule acuminata" at the apex, which is not true of *A. sericea* Dunal, and by its fruit, de-



ANNONA JENMANII SAFFORD.



ANNONA TRINITENSIS SAFFORD.



ANNONA LONGIPES SAFFORD.

scribed as verrucose and resembling a strawberry, instead of echinate or muricate like that of the true *A. sericea* Dunal growing in French Guiana (fig. 42). It may be regarded as a broad-leaved representative of *A. sericea*, growing on the Island of Trinidad, intermediate, perhaps between *A. sericea* and *A. jamaicensis* Sprague, just as *A. angustifolia* Huber may be regarded as a narrow-leaved representative of the same species growing in Brazil, intermediate, perhaps, between *A. sericea* and *A. paludosa* Aubl.

EXPLANATION OF PLATE 88.—Branch, showing lower surface of leaves and base of old, extra-axillary peduncle from which flower has been broken. Photographed from type in Kew Herbarium. Natural size.

4. *Annona longipes* Safford, sp. nov.

LONG-STEMMED ANNONA OF VERACRUZ.

A tree 10 meters high; young branches slender, clothed with dense long soft fulvous pubescence, at length glabrate, with cinnamon-colored or reddish brown bark bearing numerous white lenticels; leaves distichous; petioles 8 to 13 mm. long, densely clothed with long fulvous velvety pubescence; blades ovate, 9 to 14 cm. long and 4 to 6.5 cm. broad, acute or acuminate at the apex, usually rounded at the base, membranaceous, pellucid-punctulate, olive green when dry, sparsely pubescent above except along the impressed hairy midrib, clothed beneath with sparse white hairs except along the fulvous or pale rufous midrib and lateral nerves (12 to 14 on each side), these densely hairy, somewhat prominent beneath and connected by oblique veins scarcely visible above; lower leaves of flowering branches smaller than the upper and sometimes obtuse or retuse at the apex; peduncles solitary, extra-axillary, very long (30 to 42 mm.), persistently slender, clothed with persistent dense fulvous velvety pubescence with a scale-like pubescent bracteole at the base and a second smaller bracteole below the middle; flowers not observed; fruit shaped like a strawberry, broadly conoid, rounded at the apex, 25 mm. long and 21 mm. in diameter, the surface finely ferrugineous-tomentose, without projections but covered with gibbous areoles corresponding to the individual carpels, the latter closely cemented together and terminating each in an inconspicuous appressed point; seeds asymmetrically obovate, often obliquely truncate at the apex and with a swollen caruncle at the base, light brown, smooth, 10 to 11 mm. long and 5 to 6 mm. broad, easily separable from the scant pulp. (PLATE 89.)

Type in the U. S. National Herbarium, no. 45591, collected on the slope of a hill near the outlet of Lake Catemaco, Canton de los Tuxtlas, southeastern Veracruz, Mexico, April 28, 1894, by E. W. Nelson (no. 430).

DISTRIBUTION: Southern Veracruz, near the coast of the Gulf of Campeachy, at an altitude of 300 meters. Known only from the type locality.

Although undoubtedly related to the silky annonas, this species is separated from them by the dense, erect, velvety, fulvous or pale rufous pubescence of its younger parts, which are never appressed ferrugineous sericeous, as in *A. sericea* and its close allies. It is also set apart by its fruit, which is not echinate nor muricate, and above all by its long, persistently slender and velvety peduncles.

EXPLANATION OF PLATE 89.—Drawing, by Mr. A. B. Boettcher, of fruit-bearing branch; also longitudinal section of fruit and seed. Natural size.

5. *Annona holosericea* Safford, sp. nov.

VELVETY ANNONA OF NICOYA.

A small tree; ultimate branches densely fulvous-tomentose when young, at length glabrate, with grayish brown bark, this plicate-striate when dry and bearing very small inconspicuous lenticels; old leaf scars prominent, each bearing a tuft of fulvous tomentum; leaves distichous; petioles 4 to 5 mm. long, densely fulvous-tomentose; blades orbicular to obovate, rounded or cuneate at the base, the lowermost on the

flowering branches subreniform and often retuse; upper obovate leaves (young specimens only observed) 7 cm. long and 4 cm. broad; orbicular leaves 5 or 6 cm. in diameter; lowermost emarginate leaves 3 to 4 cm. in diameter; all of them membranaceous, punctulate, above velvety-pubescent and at length glabrate except along the impressed midrib, beneath clothed with dense soft fulvous or pale rufous tomentum on the prominent midrib and lateral nerves (8 to 12 on each side) and with grayish or olivaceous tomentum between the nerves; lateral nerves of the lowermost leaves connected by veins at right-angles to them; peduncles short, solitary, 1-flowered, extra-axillary, 7 to 9 mm. long, densely clothed with tomentum like that of the young branchlets and bearing a small tomentose bracteole below the middle; sepals broadly ovate-triangular, 4 or 5 mm. long, obtusely acuminate, clothed on the outside with dense fulvous tomentum; petals 3, broadly ovate, 12 mm. long and 10 or 11 mm. broad, acute or obtuse, thick and leathery, clothed with short pale brown velvety tomentum without and within; receptacle convex, clothed with straight erect pale fulvous hairs between the stamens and carpels; stamens numerous, 2 to 2.5 mm. long, the connective expanded above the parallel linear pale yellow pollen sacs, its surface velvety, densely covered with short fine brown hairs; carpels 1.5 to 2 mm. long, entirely clothed with pale fulvous hairs and bearing broadly ovoid or spheroid stigmas, these densely covered with erect pale fulvous or straw-colored hairs and resembling minute echinate burs under the lens, at the time of pollination becoming suffused with a viscous brown fluid and at length falling off; fruit not observed, but undoubtedly short-peduncled and velvety. (PLATES 90, 91, B.)

Type in the U. S. National Herbarium, no. 592568, collected on the wooded hills of Nicoya, Pacific coast of Costa Rica, May, 1900, by A. Tonduz (no. 13930); duplicate in the herbarium of the New York Botanical Garden.

DISTRIBUTION: Pacific coast of Costa Rica; known only from the type locality.

Annona holosericea is distinguished from all its congeners by its orbicular leaves and its velvety essential parts, of which both the connectives of the stamens and the outer stigmas (before becoming cemented together at the time of pollination) are conspicuously hairy, as seen under the lens. The connectives differ from those of the stamens of *A. sericea* and its close allies in being covered with very many fine hairs instead of comparatively few coarse ones, and the stigmas resemble miniature echinate burs instead of being covered with rounded tubercles as in the species referred to.

EXPLANATION OF PLATES 90, 91.—Pl. 90, photograph of the type specimen. Natural size. Pl. 91, A, photograph of flower of *Annona sericea*, type collection, figured by Dunal. B, photograph of flower of *A. holosericea*, type collection. Both scale 6.

6. *Annona spraguei* Safford, sp. nov.

VELVETY ANNONA OF PANAMA.

A tree 6 to 16 meters high; ultimate branchlets rufous-tomentose when young, soon becoming glabrescent, and at length glabrate, with reddish brown bark thickly dotted with small whitish lenticels; old leaf scars prominent, lined with dense rufous tomentum; leaves distichous; petioles (of young leaves) 7 to 9 mm. long, densely rufous-tomentose; blades oblong-lanceolate to obovate-oblong, 10 to 20 cm. long and 3 to 6 cm. broad, acuminate at the apex and rounded or obtusely cuneate at the base, pellucid-punctulate, sparsely pubescent above with scattered grayish hairs, densely and softly sericeous-pubescent beneath with appressed grayish olivaceous hairs except along the rufous-tomentose midrib and lateral nerves; lateral nerves 20 to 26 on each side, prominent beneath; blades of the lowermost leaves on the flowering branches rounded or retuse at the apex, cuneate at the base, much smaller than the rest, sometimes obcordate; flowers 3-petaled, large, yellow, subglobose in bud; peduncles solitary, extra-axillary, usually issuing from a point near the base of a young branchlet, 9 to 14 mm. long, ferrugineous-tomentose, with a small ovate bracteole above the



ANNONA HOLOSERICEA SAFFORD.



A. *ANNONA SERICEA* DUNAL.



B. *ANNONA HOLOSERICEA* SAFFORD.



ANNONA SPRAGUEI SAFFORD.



ANNONA SPRAGUEI SAFFORD.

middle; sepals ovate-acuminate, 8 to 10 mm. long, 6 mm. broad at the base, clothed on the outside with ferrugineous tomentum like that of the petiole, within glabrous at the base, elsewhere shortly appressed-pubescent; petals suborbicular, obtusely apiculate, thick and leathery, concave, 18 to 23 mm. long and 17 to 19 mm. broad, clothed on the outside with short dense velvety fulvous puberulence and on the inside with fine tomentulum, olive yellow with a broad dark brown spot covering the lower half; receptacle convex, clothed with very short straight fine whitish hairs; stamens numerous, crowded, 3.3 to 3.8 mm. long, with a very short flat filament and parallel linear pollen sacs 2 to 2.7 mm. long; connective expanded above the pollen sacs into a yellow head, this minutely muriculate with glossy points; gynoecium 7 to 9 mm. in diameter, composed of crowded carpels about 4 mm. long, united into a solid mass, the ovaries about equal to the styles in length, clothed with whitish sericeous hairs, the pale yellow styles more or less prismatic, terminating in a rounded stigmatic head, the whole surface minutely velvety as seen under the microscope; fruit spheroid, 5 cm. in diameter, the component carpels produced into long-attenuate fleshy claw-like protuberances, the surface velvety and each with a median longitudinal groove on the side remote from the peduncle; seeds oblong, 7 to 9 mm. long by 4 to 5 mm. broad, dull brown, with a caruncle at the base. (PLATES 92, 93. FIGURE 43.)

Type in the U. S. National Herbarium, no. 716048, collected at Gamboa, Canal Zone, Isthmus of Panama, April 9, 1911, by H. Pittier (no. 3409). "A tree 5-6 meters high; leaves soft, tomentose; petals thick."

DISTRIBUTION: Isthmus of Panama, Canal Zone to Rio Tuyra, Darien.

SPECIMENS EXAMINED: CANAL ZONE—Gamboa, near Matachin, type collection, flowers and leaves. DARIEN—Marraganti and vicinity, Rio Tuyra, 10 to 200 feet elevation, *R. S. Williams*, April, 1908, flowers, fruit and leaves, "A tree 50 feet high, with a trunk 14 inches in diameter."

To this species should probably be referred Sutton Hayes's no. 127, collected at Obispo Falls, near Barbacoas, Isthmus of Panama, cited by Hemsley as "*Anona* sp. (?*Anonae sericeae*, var. *foliis pedalis*),"¹ and described by T. A. Sprague under the name *Anona uncinata*.² The latter name is unavailable, having been previously used by Lamarck.³ If Hayes's plant, which I have not had the opportunity of comparing with the material upon which the present species is based, proves to be identical with the latter, it must assume the new specific name.

The leaves of Hayes's plant are considerably larger than those of the material examined, and a photograph of the fruit in the Kew Herbarium shows it to differ from that of Williams's specimen in the New York Botanical Garden in being ovoid-globose instead of spheroid and in having the claw-like tips of the carpels directed toward the peduncle instead of away from it, as in the latter (fig. 43).

Annona spraguei is named in honor of Mr. Thomas Archibald Sprague, of the Royal Botanic Gardens, Kew, by whom Dr. Hayes's plant was described, as a tribute to his valuable work in botanical taxonomy.

EXPLANATION OF PLATES 92, 93.—Pl. 92, photograph of a flower of the type collection, preserved in alcohol, with two petals removed, so as to show the essential parts, and also of the gynoecium of another flower showing the consolidated mass of carpels with the sericeous-hairy ovaries surmounted by the prism-shaped styles terminating in swollen stigmas. Scale 5. Pl. 93, photograph of the type in the United States National Herbarium. Natural size.



FIG. 43.—Leaf and fruit of *Annona spraguei*. Scale $\frac{1}{2}$.

¹ Biol. Centr. Amer. Bot. 1: 19. ² Bull. Herb. Boiss. II. 5: 701. 1905.

³ Lam. Encycl. 2: 127. 1786.

7. *Annona cercocarpa* Safford, sp. nov.

ANONCILLO OF THE MAGDALENA RIVER.

Annona echinata? Triana & Planch. Prodr. Fl. Novogran. 28. 1862, not *A. echinata* Dunal, 1817.

Branchlets at first ferrugineous-pubescent, soon becoming glabrate, dark reddish brown to black, set with whitish lenticels; petioles 4 to 5 mm. long, broadly channeled above, at first appressed-pubescent, at length glabrate; blades membranaceous, punctulate, those on the upper part of the flowering branches ovate to obovate-oblong, acute or acuminate at the apex and rounded or cuneate at the base, 9 to 9.5 cm. long and

3.5 to 3.9 cm. broad, with 10 to 12 secondary nerves on each side the midrib; lower leaves shorter and broader, 6.7 cm. long and 4.2 cm. broad, with 9 to 11 lateral nerves on each side; lowermost leaves smallest, broadly cordate, 2.4 cm. long and 2.3 cm. broad; all of them at first pubescent above, densely so along the impressed midrib and lateral nerves, at length glabrate; beneath conspicuously veined, with the veins at right angles to the secondary nerves, these together with the midrib clothed with short pale rufous pubescence, the remainder of the blade beneath sparsely rufous-pubescent; peduncles solitary, extra-axillary, 17 mm. long in fruit, at length glabrate; flowers not observed; calyx lobes broadly triangular, acute; carpels numerous; fruit spheroid, about 28 mm. in diameter, the component carpels pilose, terminating each in a slender appressed-hirsute more or less curled tail; seeds obovate or obpyramidal, 5 to



FIG. 44.—Leafy twig and fruit of *Annona cercocarpa*, the fruit somewhat enlarged. *a*, Tail-like tip of carpel; *b*, seeds. *a*, Scale 5; *b*, slightly enlarged.

7 mm. long by 4 mm. broad, somewhat compressed, with a smooth hard brown testa and a conspicuous caruncle at the base. (PLATE 94. FIGURE 44.)

Type in the Kew Herbarium (from Herbarium Hookerianum, 1867), collected at San Pablo on the Magdalena River, Province of Mompox, New Grenada [Colombia], 1851–1857, by J. Triana; duplicate in De Candolle Herbarium.

DISTRIBUTION: Known only from type locality.

EXPLANATION OF PLATE 94.—Photograph of type specimen.



ANNONA CERCOCARPA SAFFORD.





ANNONA ECHINATA DUNAL.





ANNONA ECHINATA DUNAL.

8. *Annona echinata* Dunal.

PRICKLY ANNONA OF FRENCH GUIANA.

Annona echinata Dunal, Monogr. Anon. 68. pl. 4. 1817.

Branches divaricate, clothed when young with ferrugineous hairs, at length glabrate, blackish, rugose, and bearing many lenticels; petioles 5 mm. long, deeply grooved above, at first minutely appressed-pubescent, at length glabrescent; blades membranaceous or subcoriaceous, thicker than those of *A. sericea*, pellucid-punctate, those on the upper parts of the flowering branches ovate-oblong or ovate-lanceolate, somewhat acute or obtusely acuminate at the apex, rounded or cuneate at the base, glabrous above, the midrib impressed and bordered on each side with numerous very short raised veins at right angles to it, the secondary nerves (8 to 10 on each side) sharply defined, connected by reticulating veins; beneath clothed with fine short dull grayish ferrugineous pubescence or tomentulum and reticulated between the prominent midrib and secondary nerves; lowermost leaves on flowering branches smaller and relatively broader, sometimes obtuse or retuse at the apex as in many other species of the genus; peduncle solitary, 1-flowered, 11 mm. long (in the type specimen), extra-axillary, issuing from the base of a new branchlet and apparently terminal on account of the abortion of the portion of the branchlet beyond it (as in many other Annonaceae), ferrugineous-tomentose or hirtellous and bearing a small tomentose bracteole below the middle; flowers similar in size and shape to those of *A. sericea*, spheroid in bud, normally 3-petaled, but sometimes in the rainy season (according to Sagot) with 3 additional inner petals alternating with the outer and closing the seams between them; calyx 3-lobed, 5 mm. in diameter, the divisions broadly triangular and obtuse, clothed on the outside like the peduncle with ferrugineous hairs; petals broadly ovate or suborbicular, obtuse, thick, coriaceous, concave, 11 mm. long and 10 mm. broad (in type flower), clothed on the outside with minute ferrugineous pubescence; stamens numerous 2 to 2.5 mm. long, with a short broad filament, linear pollen sacs, and a connective expanded into a swollen head, this minutely papillose or muriculate but devoid of hairs; carpels numerous, united in a conoid gynæcium, the ovaries clothed with appressed ferrugineous hairs; fruit ovoid, small, 24 mm. long by 17 mm. broad (fruit of type possibly immature), bearing numerous recurved protuberances corresponding to the individual carpels, the surface clothed with fine appressed ferrugineous pubescence; seeds oblong, 6 mm. long and 3 mm. broad; peduncle at length thickened and woody, sometimes apparently terminal from the abortion of the portion of the branch beyond it. (PLATES 95, 96.)

Type in the Prodromus Herbarium of De Candolle at Geneva (ex Herb. Lhéritier), collected about 1795 at "Cayenne" (French Guiana) by J. B. Patris.

DISTRIBUTION: Guiana and probably Brazil.

SPECIMENS EXAMINED: FRENCH GUIANA—"Cayenne," Patris, type collection, leaf, stamens, and tip of carpel; Mana, Sagot 6, leaf and stamens, from Kew Herbarium.

This species is undoubtedly closely related to *A. sericea* Dunal, but differs conspicuously from that species in the character of the indument of the leaves and the absence of hairs on the swollen terminal head of the connective of the stamens. Its ovoid, echinate fruits resemble miniature soursops (*A. muricata* L.). The recurved carpel tips are somewhat like those of *A. cercocarpa* described above, but differ from them in their less length and in their much finer, appressed pubescence, the carpels of *A. cercocarpa* being prolonged into tail-like appendages covered with relatively coarse, strigose hairs (fig. 44). The present species is also sharply distinct from the preceding in the shape and texture of its leaves, as indicated by the accompanying illustrations.

EXPLANATION OF PLATES 95, 96.—Pl. 95, photograph of type specimen in De Candolle Prodromus Herbarium. Natural size. Pl. 96, drawing from type material, that of fruit reproduced from original plate; a, petal; b, stamen; c, cross section of fruit; d, tip of mature carpel; e, immature carpel bearing style. Figs. a and c, natural size; b and e, scale 20; d, scale 8.

9. *Annona acuminata* Safford, sp. nov.

SMALLER WILD ANNONA OF PANAMA.

Anona echinata Hemsl. Biol. Centr. Amer. Bot. 1: 19. 1879, not Dunal, 1817.

A small tree 5 to 7 meters high with slender branches roughened by thickly crowded prominent reddish brown lenticels; very young branchlets clothed with minute appressed ferrugineous hairs scarcely visible even with the aid of a lens, very soon glabrate; leaves small, thin, membranaceous, glabrate, pellucid-punctulate (those of flowering branches only observed), 6.5 to 8 cm. long and 1.8 to 2.2 cm. broad, lanceolate or oblong-elliptical, gradually acuminate at the apex, the tip usually rounded, acute at the base, the blade decurrent on the short thick channeled petiole (1.5 to 3 mm. long), often conduplicate or revolute; midrib impressed above, prominent beneath, ferrugineous or cinnamon brown, and bearing minute scattered appressed hairs when young, but at length glabrous or nearly so; lateral nerves 10 to 12 on each side, not impressed above, distinct beneath and colored like the midrib, glabrous, dichotomously branching and anastomosing before reaching the margin; peduncles solitary, 1-flowered, extra-axillary, sometimes nearly opposite a leaf, at first minutely appressed-pilose, at length glabrate, 12 to 16 mm. long, remarkable in comparison with closely related species for two linear-lanceolate acuminate bracteoles 2 to 4 mm. long, one situated at the base and one at or a little above the middle; flower subglobose in bud, about 15 mm. in diameter; calyx gamosepalous, subtriangular, with three slender acuminate points projecting from the broad base, appressed-pilose on the outside and with a fringe of stiff rufous hairs within at the base of the receptacle; receptacle convex, clothed with pale yellow hairs between the bases of the stamens; stamens numerous, 2.5 mm. long, the connective expanded into a broad flat hood above the pollen sacs, its surface muriculate with short stiff points but without hairs; pollen bright orange yellow, in two vertical columns of tetrads; carpels numerous, the minutely hirtellous ovaries united into a disk-like mass and bearing club-shaped, easily detached styles 1.5 mm. long; fruit not observed. (PLATE 97.)

Type in the Kew Herbarium (from Herbarium Hookerianum, 1867), collected at the Bojo Station, Panama Railroad, Isthmus of Panama, June, 1861, by Sutton Hayes (no. 142). "A small tree, 15 to 20 feet high."

EXPLANATION OF PLATE 97.—Main figure, drawing of type by A. B. Boettcher. Natural size. Fig. a, flower, showing long peduncle with acuminate bracteoles; b, receptacle, bearing a few stamens and the mass of ovaries denuded of their styles; c, carpels, composed of short hairy ovaries surmounted by club-shaped styles; d, stamens, showing linear pollen sacs, one of which has opened, displaying the pollen grains in tetrads, and the expanded, muriculate connective heads. a, Natural size; b, scale about 2; c, scale about 10; d, scale 16.

10. *Annona jamaicensis* Sprague.

WILD ANNONA OF JAMAICA.

Annona jamaicensis Sprague, Bull. Herb. Boiss. II. 5: 701. 1905.

Annona sericea Griseb. Fl. Brit. W. Ind. 5. 1864, not Dunal, 1817.

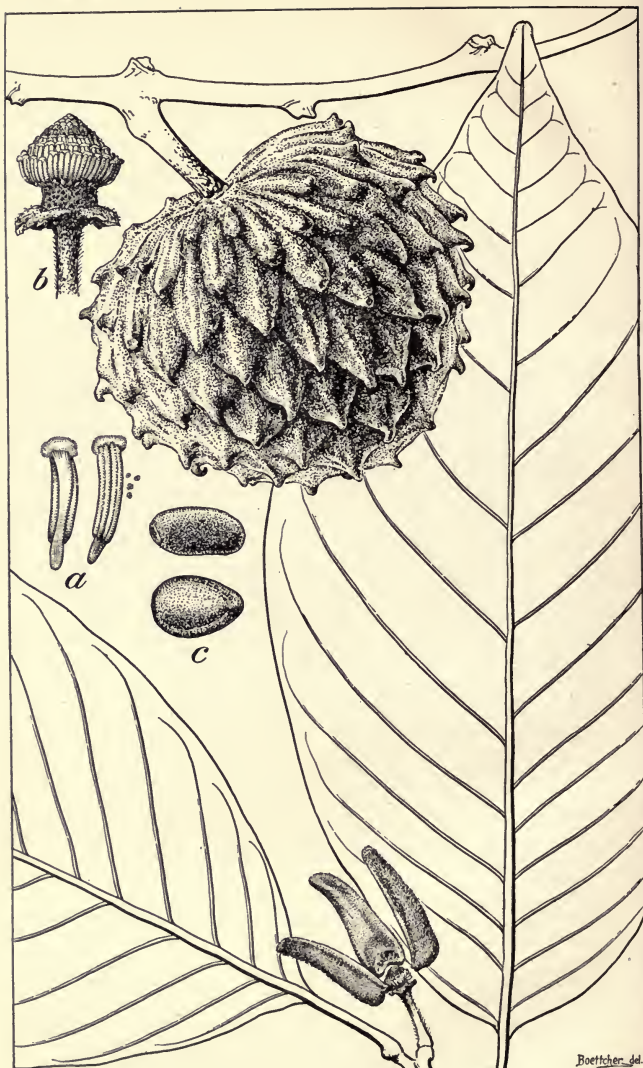
A slender tree 3 to 9 meters high; young branchlets ferrugineous-pubescent, soon glabrescent; branches grayish brown or reddish brown, bearing many inconspicuous brownish lenticels; old leaf scars prominent, lined with ferrugineous tomentum; petioles 7 to 18 mm. long, channeled above, finely appressed-pubescent at first, at length glabrescent; blades ovate or obovate to obovate-oblong, shortly and obtusely acuminate at the apex and rounded or obtusely cuneate at the base, 10 to 20 cm. long, 4.5 to 8.5 cm. broad (those near the base of young branches often considerably smaller), glabrous above, finely appressed-pubescent beneath, at length sparsely so except along the ferrugineous midrib and lateral nerves; midrib impressed above, prominent beneath; lateral nerves slightly curved, 11 to 18 on each side the midrib,



ANNONA ACUMINATA SAFFORD.



ANNONA JAMAICENSIS SPRAGUE.



ANNONA JAMAICENSIS SPRAGUE.

not impressed above, prominent and sharply defined beneath; peduncle 8 to 12 mm. long, ferrugineous-tomentose, with a small tomentose bracteole near the middle; flowers ovoid to oblong in bud, 3-petaled; calyx 3-parted, the lobes broadly ovate, obtuse or obtusely acuminate, 3 mm. long and 3 mm. broad at the base, clothed on the outside with ferrugineous tomentum like that of the peduncle; petals ovate to oblong, obtuse, 11 to 20 mm. long and 6 to 8 mm. broad, thick and leathery, clothed on the outside with fine ferrugineous velvety tomentum, lined within except near the reddish brown base with fine grayish tomentulum; stamens numerous, 1.6 to 2 mm. long, the connective somewhat broader than the lobes of the whitish pollen sacs, minutely papillose (under the microscope); carpels numerous, closely crowded in a conoid gynoecium, the styles together with the ovaries about 1.25 mm. long, the latter clothed with ferrugineous sericeous hairs; stigmas compressed-ovoid, 0.5 mm. long, cemented together at the time of pollination by a reddish brown viscous fluid; fruit globose or somewhat oblate, more or less umbilicate at the base, 4 to 6 cm. in diameter, clothed with grayish brown pubescence, with the carpels produced into tubercles usually hooked or incurved at the tips; seeds 12 to 16 mm. long, 6 to 10 mm. broad, obovate, somewhat compressed, reddish brown or tan-colored, with a smooth thin testa more or less wrinkled by the inclosed ruminant albumen. (PLATES 98, 99.)

Type in the Kew Herbarium, collected near Bath, eastern Jamaica, by William Purdie, 1844. Cotypes, without definite locality, collected by March (nos. 4, 7, 1571) and Alexander Prior (also cited by Grisebach under "*A. sericea*").

DISTRIBUTION: Known only from the island of Jamaica.

SPECIMENS EXAMINED: JAMAICA—Without definite locality, 1849–50, *Alexander Prior*, in Gray Herbarium (with ovoid flower bud); roadside near Hampton, Santa Cruz Mountains, alt. 700 meters, September 4, 5, 1907, *N. L. Britton* 1196, in herb. New York Botanical Garden (with almost mature fruit); Sheldon Road, St. Andrew, alt. 750 meters, September 10, 1897, *William Harris*, 6861, in U. S. National Herbarium (with fully developed flower and fruit).

Annona jamaicensis has been known hitherto from specimens in which the flowers were evidently immature. The petals were described by Sprague as ovate, obtuse, 11 to 12 mm. long and 8 mm. broad. The accompanying drawing (pl. 99) shows them to be longer and relatively narrower when fully developed, approaching the shape of the petals of *A. cherimola* and its allies, but distinguished from them in not being triquetrous or keeled on the inner face. Moreover, the connective of the stamens is not so much swollen as in the section to which those species belong; and the incurved tips of the mature carpels serve also to prevent the confusion of this species with *A. cherimola* Mill., which is sometimes cultivated in the mountains of Jamaica. The flower buds somewhat resemble those of *A. sericea* when immature, but the indument of the petals in the present species is more velvety and of a more reddish color, while the stamens never bear hairs on the connective terminal. In addition to these points of difference the leaves are relatively broader and are never clothed with the dark red, soft, velvety lining of the leaves of *A. sericea* and its close allies.

EXPLANATION OF PLATES 98, 99.—Pl. 98, photograph of Alexander Prior's specimen in the Gray Herbarium (cotype collection), with immature, ovoid, unopened flower bud. Pl. 99, main figure, drawing of specimen in the U. S. National Herbarium (from herb. Public Garden, Jamaica), by A. B. Boetticher, showing leaves, flower, and fruit. Natural size. Fig. a, stamens; b, flower with petals and some of the stamens removed; c, seeds. Fig. a, scale 12; b, scale nearly 3; c, natural size.



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